Ecological Site Description—Rangeland

ClayPan (CP), 11–14" MAP

MLRA: 58AC – Sedimentary Plains, Central
R058AC054MT

1. Physiographic features:

This ecological site occurs on nearly level to strongly sloping sedimentary plains, terraces and fans.

Landform: plains, fans, terraces
Elevation (feet): 2,250–4,500
Slope (percent): 0–15, mainly less than 8
Depth to Water Table (inches): greater than 60
Flooding: none
Ponding: none
Runoff Class: high to very high
Aspect: All, not significant

2. Soils:

These soils are over 20 inches deep and have a surface texture that can vary from fine sandy loam to clay loam. Within 2–8 inches of the surface is a hard to extremely hard clayey argillic horizon having strong columnar or prismatic structure. Salt and lime accumulations are often evident in the lower part of the B horizon. Root penetration is restricted by the argillic horizon, with the roots becoming flattened and tending to follow cracking in the subsoil.

Available Water Holding Capacity to 40" (inches): 5–8
Drainage Class: well
Salinity/Electrical Conductivity (mmhos/cm): non-saline to slightly saline (0–8) above the ClayPan
Sodium Absorption Ratio (SAR): mainly $\leq$ 13 above the ClayPan layer
Reaction (pH) (1:1 water): mainly neutral to slightly alkaline (6.6–8.4) above the ClayPan

3. Associated sites:

Mainly Dense Clay, Clayey, Silty, and Saline Upland. Occasionally Sandy, Shallow, and Shallow Clay sites have been mapped in association with the ClayPan.

4. Similar sites:

Saline Upland, Dense Clay, and Shale.

The Saline Upland site differs by being affected by soluble salts (i.e., electroconductivity will be higher), resulting in a plant community having mainly salt tolerant plants.

The Dense Clay site has non-granular heavy clays that have a very thin surface layer.

The Shale site soils are usually shallow with very little soil development evident. This site is extremely sparse and low producing.

5. Major Plant Community Types:

The following are descriptions of several plant communities that may occupy this site:

6. Plant Community 1: Tall and Medium Grasses/ Forbs/ Shrubs: The physical aspect of this site in the Historical Climax (HCPC) is that of a moderately sparse grassland and shrub land that is dominated by cool season grasses with shrubs distributed throughout. Approximately 70–80% of the annual production is from grasses and sedges, 1–5% from forbs, and 2–10% is from shrubs and half-shrubs. The canopy cover of shrubs is 1 to 10%.

This is the interpretive plant community and is considered to be the Historic Climax Plant Community (HCPC) or Potential Plant Community (PPC) for this site. This plant community contains a diversity of tall and medium height, cool season grasses (**green needlegrass, western or thickspike wheatgrass, and bluebunch wheatgrass**), and short grasses (**blue grama, Sandberg bluegrass**). There are numerous forbs that occur in smaller percentages. Shrubs and half-shrubs such as **Nuttall's saltbush and winterfat** are common. **Wyoming big sagebrush** is also often a common component of this community.

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This plant community is well adapted to the Northern Great Plains climatic conditions. The diversity in plant species and presence of tall, deep-rooted perennial grasses allows for drought tolerance. Plants on this site have strong, healthy root systems that allow production to increase significantly with favorable moisture conditions. Abundant plant litter is available for soil building and moisture retention. This plant community provides for soil stability and a functioning hydrologic cycle.

Plant Community 2: Medium and Short Grasses/ Forbs/ Shrubs: This community occurs due to minor climate shifts or slight variations in soils and/or topography or disturbance, including non-prescribed grazing. Dominants include **Wyoming big sagebrush** and increaser grasses such as **western or thickspike wheatgrass, Sandberg bluegrass and blue grama**. The medium and tall grasses such as **green needlegrass and bluebunch wheatgrass** will still be present, sometimes in relatively large amounts. The desirable shrubs/half-shrubs such as Nuttall's saltbush and winterfat will be somewhat less prevalent. Palatable and nutritious forbs will begin to be replaced by less desirable and more aggressive species such as **scarlet globemallow**.

Grass biomass production and litter become reduced on Community 2 as the taller grasses become less prevalent, increasing evaporation and reducing moisture retention. Additional open space in the community can result in undesirable invader species. These plant communities provide for moderate soil stability.

Plant Community 3: Shrubs and Half-shrubs/ Short Grasses/ Cactus: This is a disturbance induced community, with dominants including **Wyoming big sagebrush, or greasewood** in some situations. Short grasses such as **Sandberg bluegrass and blue grama** become more prevalent. **Western or thickspike wheatgrass** will still be relatively abundant. Bluebunch wheatgrass and green needlegrass will still be present, but in much smaller amounts. Palatable forbs will be mostly absent. **Fringed sagewort and plains pricklypear** will tend to become more abundant. Barren pans may become more apparent as a part of this community.

Plant Community 4: Shrubs and Half-Shrubs/ Annuals/ Short Grasses/ Cactus: If heavy disturbance continues, plant community 3 can deteriorate to one primarily composed of shrubs and half-shrubs (**Wyoming big sagebrush / greasewood, fringed sagewort and broom snakeweed), short grasses (Sandberg bluegrass, blue grama), annual grasses (cheatgrass or Japanese brome, six weeks fescue), annual forbs (pepperweed, fanweed), and plains pricklypear**. There will still be some of the mid-seral species such as western or thickspike wheatgrass present. The taller grasses will occur only rarely, often underneath the shrub canopy or mixed in with the cactus. Palatable forbs will be mostly absent. Weedy forbs (e.g., **thistles, desert alyssum, and curlycup gumweed**) are likely to invade.

Plant Communities 3 and 4 are much less productive than Plant Communities 1 or 2, and have lost many of the attributes of a healthy rangeland. The loss of deep perennial root systems reduces total available moisture for plant growth. Reduction of plant litter will result in higher surface soil temperatures and increased evaporation losses. Annual species are often aggressive and competitive with seedlings of perennial plants. This community can respond positively to improved grazing management but it will take additional inputs to move it towards a community similar in production and composition to that of Plant Community 1 or 2. The landscape features often associated with this ecological site as well as the droughty nature of the soils severely limits the use of most common structural improvement practices.

5a. Cover and structure (Historic Climax Plant Community)

COVER TYPE	BASAL COVER (%)	CANOPY COVER (%)	AVERAGE HEIGHT (inches)
Cryptogams	0–T	0–T	0.25
Grasses/ sedges	3–10	40–60	18
Forbs	1–2	1–5	6
Shrubs	1–5	1–10	10
Litter	20–30		
Coarse fragments	0–5		
Bare ground	15–30		

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5b. Major Plant Species Composition - Historical Climax Plant Community

Common Name	Plant Symbol	Plant Group	Percent Comp.	Group Max. %	Mean Annual Precipitation (inches)			
					11	12	13	14
					(lbs./acre)	(lbs./acre)	(lbs./acre)	(lbs./acre)
Grasses and Sedges 80–85%					**640-680**	**720-765**	**800-850**	**880-935**
Western or Thickspike wheatgrass	PASM ELLAL	14	20-40		160-320	180-360	200-400	220-440
Green needlegrass	NAVI4	2	15-30		120-240	135-270	150-300	165-330
Bluebunch wheatgrass	PSSP6	2	5-10		40-80	45-90	50-100	55-110
Needleandthread	HECOC8	10	0-10		0-80	0-90	0-100	0-110
Alkali sacaton	SPAI	1	0-10		0-80	0-90	0-100	0-110
Montana wheatgrass	ELLAA	14	0-5		0-40	0-45	0-50	0-55
Sandberg bluegrass	POSE	12	0-10}	10	0-80	0-90	0-100	0-110
Plains reedgrass	CAMO	16	0-10}					
Needleleaf sedge	CADU6	16	0-5}	5	0-80 No more than 40 for any one	0-90 No more than 45 for any one	0-100 No more than 50 for any one	0-110 No more than 55 for any one
Threadleaf sedge	CAFI	12	0-5					
Prairie junegrass	KOMA	12	0-5}					
Blue grama	BOGR2	15	0-5					
Other native grasses	2GP		0-5}					
Foxtail barley	HOJU	12	0-T	T	0-T	0-T	0-T	0-T
Tumblegrass	SCPA	11	0-T					
Forbs 1–5%					**8-40**	**9-45**	**10-50**	**11-55**
Prairie thermopsis	THRH	20	0-5}	5	0-40	0-45	0-50	0-55
Wild onion	ALLIU	32	0-5}					
Eriogonum spp.	ERIOG	23	0-5}					
Biscuitroot spp.	LOMAT	24	0-5}					
Western yarrow	ACMI2	19	0-5}					
Wild parsley	MUDI	24	0-5}					
Scarlet globemallow	SPCO	20	0-5}					
Stemless hymenoxys	HYAC	24	0-5}					
Bastard toadflax	COUM	20	0-5}					
Hood's phlox	PHHO	28	0-5}					
Other native forbs	2FP		0-5}					
Two grooved poisonvetch *	ASBI2	24	0-T					
Death camas *	ZIGAD	32	0-T					
Shrubs and Half-shrubs 5–15%					**40-120**	**45-135**	**50-150**	**55-165**
Winterfat	KRLA2	35	0-5}	10	0-40	0-45	0-50	0-55
Nuttall's saltbush	ATNU2	34	0-5}		0-40	0-45	0-50	0-55
Wyoming big sagebrush	ARTRW	37	0-10}		0-40	0-45	0-50	0-55
Shadscale	ATCO	34	0-5}		0-80	0-90	0-100	0-110
Fringed sagewort	ARFR4	38	1-5}		8-40	9-45	10-50	11-55
Rabbitbrush	ERNAN5	32	0-5}	5	0-40	0-45	0-50	0-55
Greasewood	SAVE4	37	0-5}					
Other native shrubs	2SB		0-5}					
Broom snakeweed	GUSA2	37	0-T}	T	0-T	0-T	0-T	0-T
Plains pricklypear	OPPO	38	0-T}					
Total Annual Production (lbs/ac):			**100%**		**800**	**900**	**1000**	**1100**

* These plants are poisonous to some grazing animals, during at least some portion of their life cycle.

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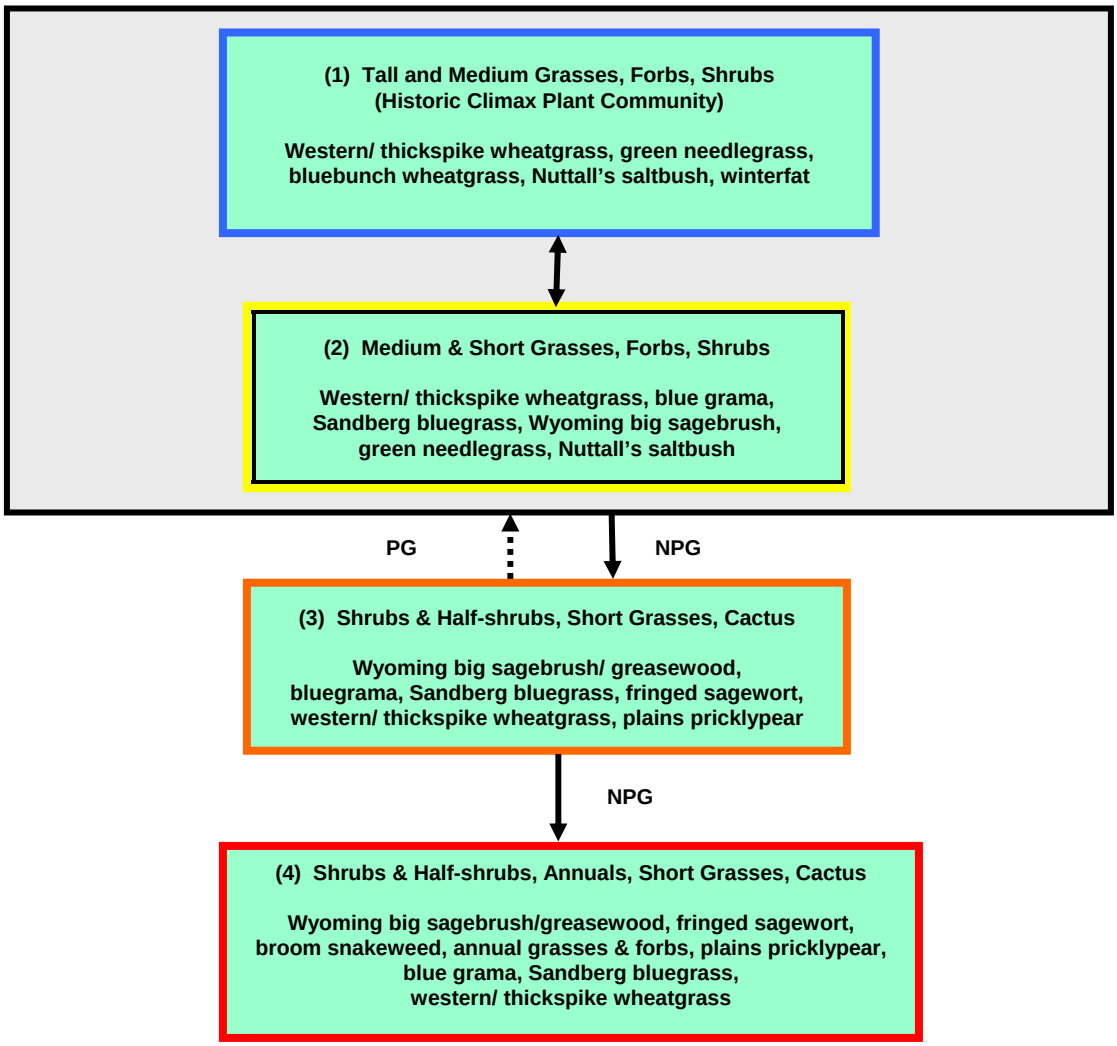
5c. Plant Communities and Transitional Pathways (diagram)



Smaller boxes within a larger box indicate that these communities will normally shift among themselves with slight variations in precipitation and other disturbances. Moving outside the larger box indicates the community has crossed a threshold (heavier line) and will require intensive treatment to return to Community 1 or 2. Dotted lines indicate a reduced probability for success. Yellow boxes indicate caution that the community may be in danger of crossing a threshold. Orange boxes represent communities that have crossed over thresholds from the HCPC and may be difficult to restore with grazing management alone. Red boxes represent communities that have severely shifted away from the HCPC and probably cannot be restored without mechanical inputs.

NOTE: Not all species present in the community are listed in this table. Species listed are representative of the plant functional groups that occur in the community.

PG = Prescribed Grazing: Use of a planned grazing strategy to balance animal forage demand with available forage resources. Timing, duration, and frequency of grazing are controlled and some type of grazing rotation is applied to allow for plant recovery following grazing.

NPG = Non-Prescribed Grazing: Grazing which has taken place that does not control the factors as listed above, or animal forage demand is higher than the available forage supply.

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6. Livestock Grazing Interpretations: Managed livestock grazing is suitable on this site as it has the potential to produce high quality forage. However, forage production can be severely limited by the soil properties. Management objectives should include maintenance or improvement of the plant community. Shorter grazing periods and adequate re-growth after grazing are recommended for plant maintenance and recovery. Heavy stocking and season-long use of this site can be detrimental and will alter the plant community composition and production over time.

Whenever Plant Community 2 (medium and short grasses and shrubs) occurs, grazing management strategies need to be implemented to avoid further deterioration. This community is still stable, productive, and healthy provided it receives proper management. This community will respond fairly quickly to improved grazing management, including increased growing season rest of key forage plants. Grazing management alone can usually move this community back towards the potential community.

Plant Communities 3 and 4 have substantially reduced forage production, and a high percentage of aggressive, non-palatable species. Once these plant communities become established, it will be much more difficult to restore the site to a community that resembles the potential with grazing management alone. Additional growing season rest is often necessary for re-establishment of the desired species and to restore the stability and health of the site. Practices such as range seeding or mechanical treatment are generally not recommended on this site.

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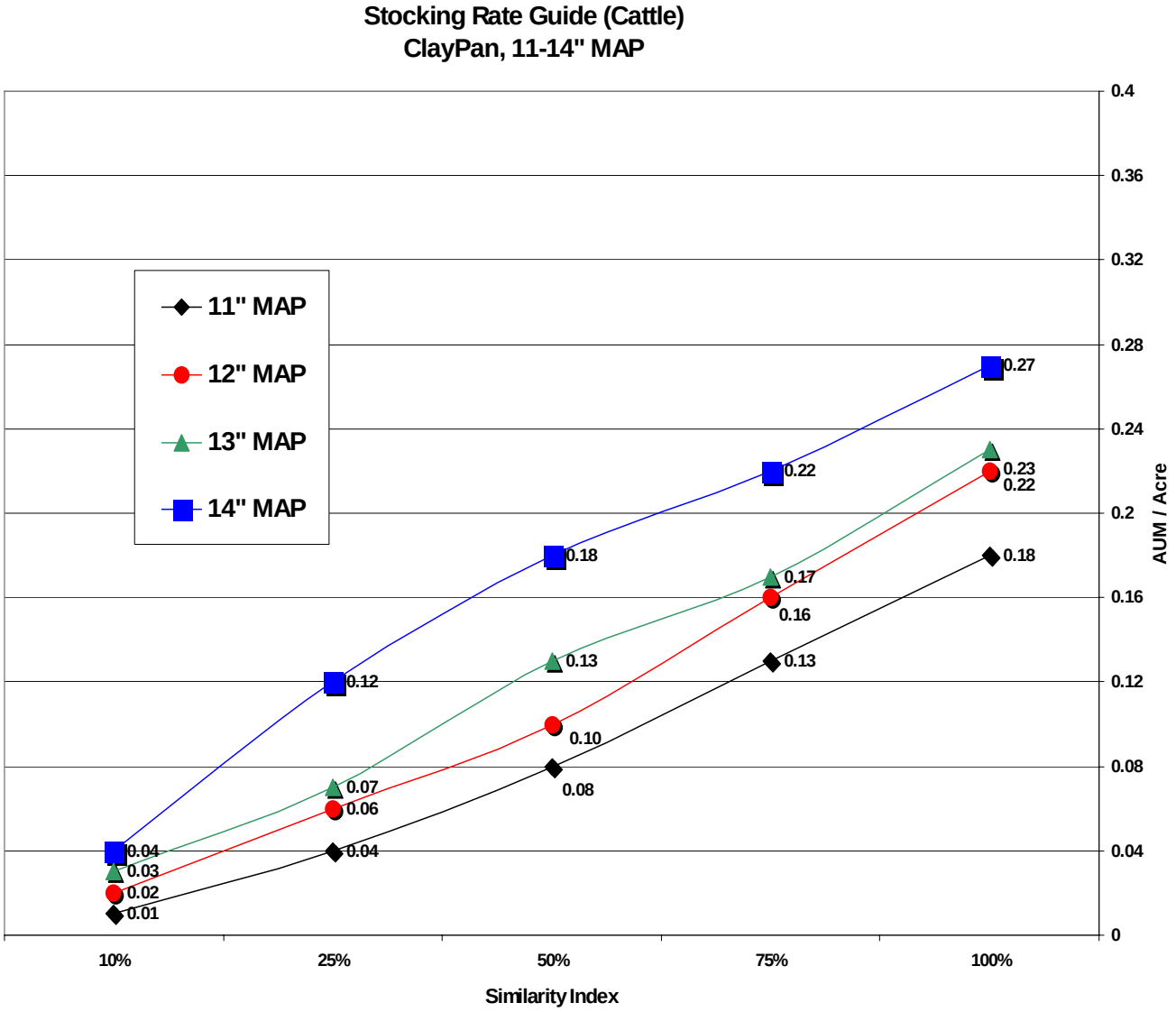
6a. Guide to Safe Stocking Rates: The following charts provide guidance for determining an initial safe stocking rate. Animal Unit Month (AUM) figures are based on averages of forage production from data collected for this site over several years. The characteristic plant communities and production values listed may not accurately reflect the productivity of a specific piece of land. These tables should not be used without on-site information collected to determine the average forage productivity of the site. Adjustments to stocking rates for each range unit must be made based on topography, slope, distance to livestock water, and other factors which effect livestock grazing behavior.



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6b. Stocking Rate Guide:

Major Plant Community Dominant Plant Species	MAP	Total Production (pounds/ac)	Cattle			Sheep		
			Forage Production	AUM/ac	Ac/AUM	Forage Production	AUM/ac	Ac/AUM
1. Tall and Medium Grasses, Forbs, Shrubs (HCPC/PPC) *Western/ thickspike wheatgrass, green needlegrass, Nuttall's saltbush, winterfat, Wyoming big sagebrush* **(S.I. >75%)**	13–14"	1000-1100	850-1000 +	.23-.27 +	3.7-4.3	900-1050 +	.25-.29 +	3.5-4.1
	11–12"	800-400	675-800 +	.18-.22 +	4.6-5.4	725-850 +	.20-.23 +	4.3-5.0
2. Medium & Short Grasses, Forbs, Shrubs *Western/ thickspike wheatgrass, blue grama, Sandberg bluegrass, Wyoming big sagebrush, green needlegrass, Nuttall's saltbush* **(S.I. 40–75%)**	13–14"	550-935	325-800	.09-.22	4.6-11.3	350-850	.10-.23	4.3-10.5
	11–12"	440-765	275-650	.08-.18	5.6-13.3	300-700	.08-.19	5.2-12.2
3. Shrubs & Half-shrubs, Short Grasses, Cactus *Wyoming big sagebrush/ greasewood, blue grama, Sandberg bluegrass, fringed sagewort, western/ thickspike wheatgrass, plains pricklypear* **(S.I. 20–40%)**	13–14"	350-715	175-425	.05-.12	8.6-20.9	200-475	.05-.13	7.7-18.3
	11–12"	280-585	150-350	.04-.10	10.5-24.4	150-375	.04-.10	9.8-24.4
4. Shrubs & Half-shrubs, Annuals, Short Grasses, Cactus *Wyoming big sagebrush/ greasewood, fringed sagewort, broom snakeweed, annual grasses and forbs, plains pricklypear, blue grama, Sandberg bluegrass, western /thickspike wheatgrass* **(S.I. < 20%)**	11–14"	160-440	50-150	.01-.04	24.4-73.2	50-175	.01-.05	20.9-73.2

Stocking rates are calculated from average forage production values using a 25% Harvest Efficiency factor for preferred and desirable plants, and 10% Harvest Efficiency for less desirable species. AUM calculations are based on 915 pounds per animal unit month (AUM) for a 1,000-pound cow with calf up to 4 months. No adjustments have been made for site grazability factors, such as steep slopes, site inaccessibility, or distance to drinking water.

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7. Wildlife Interpretations: The ClayPan ecological site occurs over large acreages on the Northern Great Plains. Conversion of ClayPan sites to cropland has caused habitat fragmentation in some areas, which may contribute to the decline of some "area sensitive" wildlife species, particularly such ground-nesting birds as the grasshopper sparrow. This site is home to a diverse native wildlife complex. Historically, huge herds of migratory bison and pronghorn as well as large numbers of sage grouse were probably the dominant "game" species in addition to a wide variety of ground-nesting songbirds, waterfowl and shorebirds, small mammals and mammalian predators. In the past, vast prairie dog towns provided habitat for such species as the black-footed ferret, burrowing owl, mountain plover and ferruginous hawk and swift fox. Invasive plant species such as leafy spurge, Canada thistle and several knapweeds are contributing to a loss of biodiversity within this ecological site. Wildlife water requirements are provided by shallow snowmelt and rainfall ponds on heavy clay pan spots, springs and seeps, intermittent and perennial streams and, in modern times, numerous artificial ponds and livestock pipelines. These areas are locally important for northern leopard frogs, tiger salamanders and a number of toad species, all of which feed on a variety of insects. Grazing, fire, drought cycles and insect population fluctuations create a shifting mosaic of wildlife habitats across this site.

Plant Community 1: Tall Grasses/ Forbs/ Shrubs (HCPC): Invertebrate diversity, including pollinator insects, is fairly high given the variety of forbs and shrubs in this community. Representative reptiles include the prairie rattlesnake, bull snake and sagebrush lizard. Common amphibians are Woodhouse's toad, tiger salamanders and the western chorus frog. The higher percentage of bare ground, and correspondingly lower litter coverage, reduce the value of this site for ground-nesting birds compared to more productive communities in silty and sandy ecological sites. However, ground nesting bird habitat is still quite good when large acreages of this community occur in solid blocks. Sage grouse use this fairly open plant community for lek sites and for feeding on sagebrush, succulent forbs and insects. Common songbird species include lark buntings, Brewer's sparrows and vesper sparrows. Small mammals are mainly seed-eating species such as deer mice and olive-backed pocket mice. The high proportion of cool season grasses on this site provides nutritious early to mid-season forage for grazers and mixed feeders such as bison and elk. Pronghorn also utilize these grasses as well as Nuttall's saltbush, winterfat and big sagebrush, especially fall through spring.

Plant Community 2: Medium and Short Grasses / Forbs/ Shrubs: The decline of green needlegrass and bluebunch wheatgrass cover reduces structural habitat diversity for small mammals and songbirds. A decrease in litter and residual vegetation adversely affects ground-nesting birds. The increase in big sagebrush cover may improve sage grouse nesting habitat and winter habitat value for sage grouse and pronghorn. Other sagebrush-grassland obligates, such as Brewer's sparrows and sage thrashers, also may benefit from an increase in big sagebrush cover.

Plant Community 3: Shrubs and Half-shrubs / Short Grasses / Cactus: Insect diversity suffers from the loss of desirable forbs and ground cover. Amphibian habitat is degraded as the ground temperature rises and soil moisture is increasingly limited. When big sagebrush dominates the cover, sage grouse and pronghorn winter habitat and breeding season habitat for Brewer's sparrows and the sage thrasher may be fairly good. However, the loss of herbaceous cover reduces habitat value for a variety of ground-nesting birds. Lark buntings and vesper sparrows will use greasewood cover for breeding habitat.

Plant Community 4: Shrubs & Half-Shrubs / Annuals/ Short Grasses / Cactus: Insects may be very abundant during population highs (i.e., grasshoppers) but diversity is low, especially of pollinators. Amphibian habitat is very degraded; ephemeral pools evaporate rapidly and the soil surface is very dry and hot during summer. Ground nesting bird habitat value is poor because of the lack of litter cover and residual plant cover in early spring. Sage grouse and Brewer's sparrows may be fairly abundant in the heavier sagebrush cover but probably suffer heavy losses while nesting on the poorly protected ground surface. Mountain plovers prefer to nest in this community type if a somewhat pebbly surface is present. Mule deer and pronghorn may utilize sagebrush and fringed sagewort during winter in this community.

8. Hydrology Data: The runoff potential for this site is very high depending on slope and ground cover/health. Runoff curve numbers generally range from 84 to 93. The soils associated with this ecological site are generally in Hydrologic Soil Group D. The infiltration rates for these soils will normally be very slow.

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9. Site Documentation:

Authors: Original: NRCS, 1983 Revised: MJR, REL, RSN, POH, 2003

Supporting Data for Site Development:

NRCS–Production & Composition Record for Native Grazing Lands (Range-417): 8
BLM–Soil & Vegetation Inventory Method (SVIM) Data: 2
NRCS–Range Condition Record (ECS-2): 10
NRCS–Range/Soil Correlation Observations & Soil 232 notes: 13

Field Offices where this site occurs within the state:

Big Sandy	Columbus	Harlowton	Roundup
Big Timber	Crow Agency	Joliet	Stanford
Billings	Fort Belknap	Lewistown	White Sulphur Springs
Chinook	Hardin	Malta	Winnett

Site Approval: This site has been reviewed and approved for use:

Loretta J. Metz 10/22/2004
State Rangeland Management Specialist **Date**

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